Noble gases in 1609, 2001 and 2006 lunar samples. A.N.Yasevich[1], S.S.Assonov[1,2], A.S.Semenova[1], Yu.A.Shukolyukov[1]. [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, 19 Kosygin str, Moscow, 117975, Russia; [2](present address) Planetary Science Research Institute, The Open University, Walton Hall, Milton Keynes, MK7 6AA, UK

Abstract. Noble gases in Luna-16 and Luna-20 samples were studied by stepwise heating. The usual elemental ratios and dependence of noble gas abundances on grain-size were observed. Luna-16 regolith is more mature than Luna-20 regolith, but the former seems to have trapped gases more recently than the latter.

Here we report preliminary results for the Luna-16 and Luna-20 samples. Previously all noble gases of Luna-16 and 20 samples were investigated by total gas extraction only [1 - 4] and only two Luna-16 samples were studied by stepwise heating [5, 6]. Xe analysis of Luna-16, 20 and 24 samples, carried out early by stepwise heating had shown an excess of ^{136}Xe and ^{132}Xe [7, 8] which might be due to presence of fission Xe. The 2001 grain size fraction exposure ages calculated using REE abundances and $^{126}Xe_{spall.}$ contents have not shown the normal dependence on grain size [8]. In order to test that the fission Xe does present in the Luna-20 samples we have analysed Luna-20 samples by stepwise heating. Another goal of the work is to study regolith sample exposure ages and gas trapping age using the $^{40}Ar/^{36}Ar$ ratio [9].

Method of analysis and samples. The noble gases were extracted by all metal system with low blank level and measured using reconstructed mass-spectrometer MI-1201 [10, 11]. A fraction 200-500 μm of gently crushed L5 Knyaginia chondrite which has enough uniform distribution of noble gases [12] was used to calibrate the sensitivity of mass-spectrometer. The samples were sieved in acetone, wrapped in Al foil and outgassed at 100°C for 12 hours before analysis. The list of samples and the size of the fractions are listed in the Table 1. The sample 1609 was taken from 0-15 cm zones of Luna-16; 2001 - from 05-14 cm zones of Luna-20 and 2006 breccia - from 23-32 cm zone of Luna-20.

Results. The measured noble gas abundances and $^{40}Ar/^{36}Ar$ ratios are given in the Table 1. They are in a good agreement with results of other investigators [1-6]. The Luna-20 grain-size fractions show the usual dependence of noble gas abundances on the grain-size. The elemental ratios showed on the figure 1 are the same for all samples, except for Xe in the 40-74 μm fraction of the 2001 sample. This fact might be due to the mixture of heavier irradiated regolith grains which had lost most of He, Ne and Ar with less irradiated ones.

The studied Luna-16 sample has lower $^{136}Xe/^{130}Xe$ and $^{134}Xe/^{130}Xe$ ratios than BEOC, the same was observed by W.A.Kaiser [5] and A.P. Vinogradov and I.K. Zadorozhny [6]. This is due to the larger contribution of cosmogenic Xe that is usually observed. The investigated Luna-20 samples have no evidences of excess of heavy Xe isotopes or signes of fission Xe. We believe that the absence of fission Xe in our samples is consistent with rather young gas trapping age. However it does not necessary mean that fission Xe could not be present in other Luna-20 samples.

To estimate the gas trapping age of the samples the $^{40}Ar/^{36}Ar$ ratio was employed. According to the $^{40}Ar/^{36}Ar$ calibration curve of O. Eugster et al. [9] we have evaluated that the gas trapping age of the 2006 breccia is approximately 1 AE and slightly younger for the 2001 grain size fractions.

We have calculated the contents of $^{21}Ne_{spall.}$ using solar Ne isotopic composition (BEOC-12, $^{20}Ne/^{21}Ne/^{22}Ne$=12.9/0.0312/1.0 [13]) and assuming the isotopic composition of cosmogenic Ne to be $^{20}Ne/^{21}Ne/^{22}Ne$= 0.8/0.8/1. The contents of $^{21}Ne_{spall.}$ for the 2001 grain size fractions increase with decreasing of grain size. In other words, the fine grain fraction have longer exposure age then the coarse ones.

Acknowledgements. *This work was supported by the Russian Basic Research*

Foundation, projects 96-05-531 and 96-05-546 (equipment expenses).

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Table 1. Noble gas abundances (in cc/g) and $^{40}Ar/^{36}Ar$ ratios of the investigated samples.

Sample, fraction	^{4}He	^{20}Ne	$^{21}Ne_{spall.}$	^{36}Ar	$^{40}Ar/^{36}Ar$	^{132}Xe
1609, 40-74μm	2.21E-01	3.53E-03	1.23E-06	5.06E-04	0.983	3.73E-08
2001, 2-5μm	2.89E-01	7.06E-03	2.24E-06	1.16E-03	1.55	9.46E-08
2001, 40-74μm	4.88E-02	1.50E-03	5.64e-07	3.00E-04	1.46	6.08E-08
2001, 194-200μm	1.91E-02	5.22E-04	2.14e-07	1.75E-04	1.65	8.73E-09
2006, breccia	1.49E-02	5.37E-04	2.39e-07	1.91E-04	2.77	1.42E-08

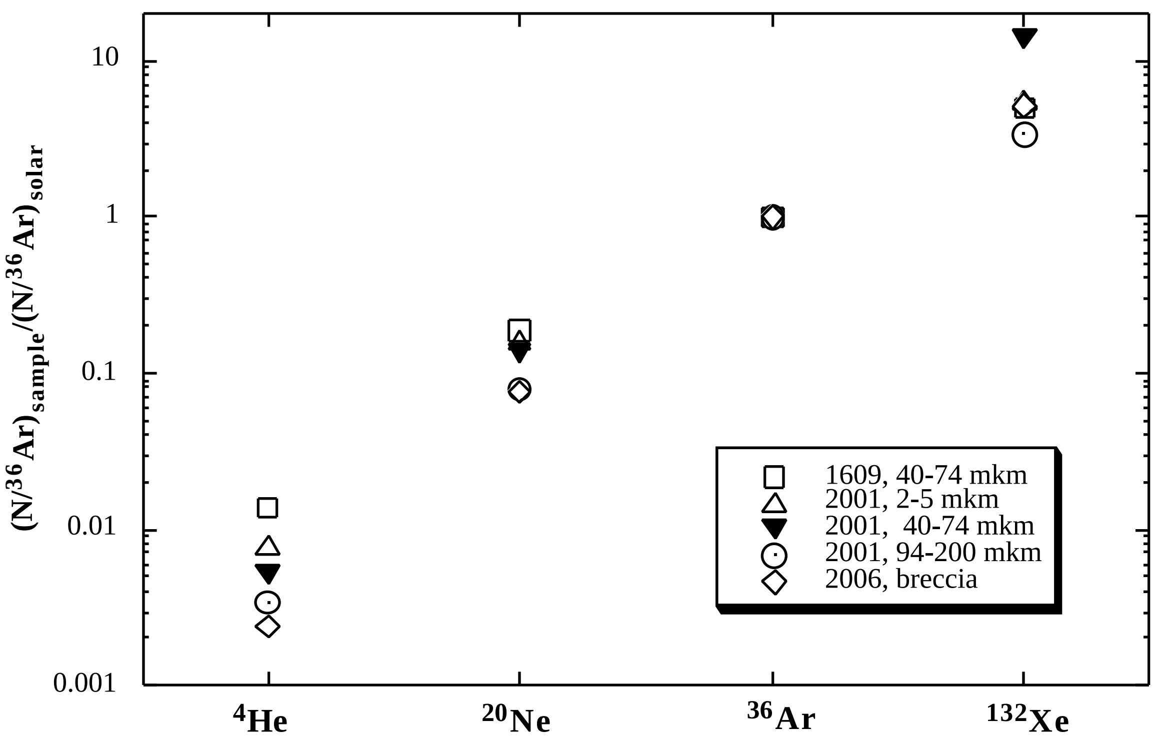

Fig. 1.